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THE CELL-THEORY.

Leçons sur la Cellule Morphologie et Réproduction faites au Collège de France pendant le semestre d'hiver 1893-94. Par Félix Henneguy. Pp. xix + 541. 362 figures. (Paris: Georges Carré, 1896.)

THE cell occupies, and has for half a century occupied, so important a position in biological science, that the literature dealing with it and the number of general works called up by this literature has become enormous, and is daily increasing. Nor is this a matter to be wondered at, for the subject is one of supreme importance to the biologist, and contains within its border the very innermost mysteries of life. But in saying this, we do not wish to be understood as giving our adhesion to this or to that modern school of thought with regard to the importance of the cell in organisms. It is sufficient for us to note the fact that, great as has been the influence of the conception of cell on biological investigations in the last fifty years, the chief merit of the founders of the cell-theory lay less in giving us that conception than in fixing attention upon the matter of which the organism is composed. To the cell-theory we owe our conception of the organism as a body composed of protoplasm—the real living matter, and of formed material—the non-living or semi-living framework. The former is the true seat of life, and the latter is produced as a result of its vital activity. This conception has been an analytical tool of the most powerful kind, and has assisted very considerably in the task of unravelling the complexity of structure and function of the parts of organisms. The cell-theory first fixed our attention upon protoplasm, and upon that most important part of protoplasm the nucleus; and it is to the study of protoplasm and of the nucleus, of their structure, relations, and activities, that the great advances in modern biology are due. This, we repeat, was the great work of the founders of the cell-theory. But they did more than this: they first showed us that the living substance is often arranged in and works through small structural units called cells; and they first gave us the idea that the organism is composed of independent or semi-independent individuals associated together in a colony for the common good. It is this idea, this hypothetical explanation of cellular structure, which constitutes the cell-theory; and it must be clearly borne in mind that the promulgation of this hypothesis was the least important part of the work of the founders of that theory. At the same time it is an undeniable fact that this hypothesis was held, and indeed is held largely at the present day; and that it has had a most important influence upon biological research. Of its value we express no opinion, but we should be wanting in our duty if we did not point out that of late years a slowly increasing number of biologists have cast doubts upon its validity and utility as an explanation of cellular structure, and are content to hold for the present that cellular structure has not received any adequate explanation, or, to use the somewhat vague words of Sachs, is a phenomenon of secondary significance, and merely one of the numerous expressions of the formative forces which reside in all matter, and in the highest degree in organic substance.

It is obvious that a work dealing with the cell in this wide sense, viz. as an equivalent for protoplasm and nucleus, must have a very large scope indeed; for if complete, it would include the whole of vegetable and animal histology and physiology. Owing to human limitations, it is in these days impossible for a single author to take this wide outlook, and we find in works dealing with the cell restrictions of various kinds. As a general rule, an author will limit himself to animal or to vegetable protoplasm, and a full consideration of the formed material is nearly always excluded. The part of the subject to which special attention is devoted—at any rate in recent works—is the structure of protoplasm, and of the nucleus and the behaviour of the nucleus in division and in conjugation. M. Henneguy is not content with any restriction of this kind, and though modestly disclaiming all idea of giving a complete account of the subject, and of having written a treatise on Cytology, he has in our opinion produced a more complete work on protoplasm and the nucleus than any of his predecessors. The work represents a course of thirty-one lectures given at the College de France in the winter of 1893-4, and is an admirable account of the state of our knowledge to that date. The author deals both with animal and vegetable protoplasm, with its chemical and physical constitution, with its structure, with the nucleus, the change which it undergoes and its relation to the cytoplasm, and with its division and its conjugation. An account of the nutrition of the cell, of the products of cellular activity, and of its functional differentiation, occupies a prominent place in the work. Finally he has a chapter on the relation of cells to each other, and another on the most important hypotheses on the constitution of protoplasm, and he begins the work by an excellent account of the growth of knowledge on the subject.

The work is of course a didactic one, and in no sense is to be regarded as an original contribution to knowledge. The author's object is to give an account of the facts which have been definitely established, relegating to the second place controversial or doubtful matters.

And in this he does well, for, as he points out, the tendency at the present day among a certain class of small workers to premature publication and to hasty generalisation, leads to most disastrous results in the accumulation of third-rate literature. A single fact, which often turns out to be no fact at all, is hidden in pages of raw and worthless speculation. "Another cause assists in accentuating this pernicious tendency. In certain schools far too much emphasis is laid upon new and still controverted observations, and classical works confirmed by numerous and reiterated observations are too often neglected, and future observers thus deprived of a sure and solid basis." He devotes a special section to the consideration of the effects of the different kinds of reagents used by histologists in altering the structure of protoplasm, and he calls the attention of his readers to the importance of the study of living protoplasm, and of checking all their results by it. This is a most important point, too often lost sight of in the rush and petty

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ambition of modern laboratories, and one which cannot be too strongly impressed on young workers.

The author's treatment of that most important subject of protoplasmic fusion is not entirely satisfactory. He distinguishes two kinds: (1) fusion in which several cells unite to form a multinucleated mass, as in the *Mycetozoa* and some *Rhizopoda;* (2) conjugation, in which two or more cells fuse to form one cell; the distinction being that while in the latter case the process is accompanied by nuclear fusion, in the former it is not. In the first place it must be noted that conjugation does not always result in the formation of one cell from two, *e.g.* many ciliate infusoria; and in the second, that it is by no means certain that nuclear fusion does not occur between the nuclei of the multinucleated masses resulting from fusion. Moreover the author falls into the common error, found even in some of the best text-books, of calling conjugation a mode of reproduction. On p. 416 he says, "J'arrive maintenant à une mode spécial de reproduction, cellulaire que nous connaissons déjà, à celui que nous avons désigné sous le nom de *conjugaison* et que nous avons distingué de la *fusion*." It is perhaps hardly necessary to point out that by reproduction the number of individuals of a species is increased, while by conjugation it is generally diminished. It is true that conjugation results in the formation of a new individuality, but not in the increase in the number of individuals.

It is hardly going too far to say that conjugation is the opposite of reproduction. It is curious that this mistake should so often be made, and it is most important to call attention to it; for the confusion between the two processes, which has no doubt resulted from their accidental association in sexual reproduction, has considerably interfered with the proper appreciation of that most mysterious and important of vital processes—fusion of nuclei and protoplasm.

With regard to technical terms, we may be allowed to call attention to our author's use of the word *Cytodieresis.* He proposes this word for the process of cellular division, which is accompanied by those characteristic transformations of the nucleus which are ordinarily termed karyokinetic, reserving the word *division* for those cases in which the nucleus divides directly. We do not inquire whether such a word is required, but we desire to point out that on the very next page (296), our author uses the word Cytodieresis as the equivalent of *Caryodieresis* (indirect nuclear division). He says: "*Division indirecte* (of the nucleus) = *karyokinesis* (Schleicher) = *cytodieresis* (Henneguy) = *mitosis* (Flemming)." The looseness of thought implied by this confusion in the use of his own word is unsatisfactory, and would by some biologists be pointed to as an example of the result of too strongly holding to a theory which does not conform with all the facts.

In criticising Weismann's suggestion that the Protozoa are immortal, he says that "a Protozoon which divides dies in the sense which we attach to the death of the higher animals, *i.e.* that its individuality disappears." Though we are quite willing to admit that Weismann's statement was more of the nature of a gallery phrase designed to catch the ear of the readers of the modern magazine article, than a serious contribution to science, and that it conveyed no new idea or suggestion, we cannot follow M. Henneguy in his criticism quoted above. For do not the higher animals also undergo numerous successive divisions in the production of their reproductive cells, which differ in no essential particular from the successive binary fissions which a Paramœcium passes through in its life-history. The only difference which can be pointed to is one merely of degree; for there is no more an absolute similarity between the two products of fission in an infusorian than there is between the products of the fission (ovum or spermatozoon and parent) which is continually taking place in the higher animals. You might just as reasonably assert that a hen dies whenever it lays an egg, as make the statement that a Paramœcium dies at each process of fission. With the words death and individual a philosopher can do much; but it behoves practical men to keep a sharp look-out on the use made of those convenient terms.

The book is well printed and illustrated; and though it is not a complete and carefully elaborated treatise on protoplasm, as the author himself is the first to admit, yet it constitutes a valuable addition to the biologist's library, and cannot fail to be of great use to the teacher as well as to the student.

A ROMANTIC NATURALIST.

From North Pole to Equator, Studies of Wild Life and Scenes in many Lands. By the Naturalist-Traveller, Alfred Edmund Brehm. Translated from the German by Margaret R. Thomson. Edited by J. Arthur Thomson, M.A., F.R.S.E. (London: Blackie and Son, Ltd., 1896.)

"BETWEEN North Pole and Equator" might have been a less attractive, but would have been a more accurate title for this book, for Siberia and northern Norway are not as far north as the Pole, nor are Nubia and the Blue Nile as far south as the Equator. Between these limits, however, the late Dr. A. E. Brehm made extensive journeys, visiting most of the principal types of country that may be found therein, and studying the characteristic faunas with the enthusiasm of a born naturalist. His great "Thierleben" is a rich repository of information on the habits of animals, the various groups of which are taken in zoological order. The present book appears to be intended as a supplement to this; for it is geographical in arrangement, and consists of a series of graphic sketches of wild life in many lands.

The work opens with a brief homage to the author by his son, and then an admirable introductory essay by the editor upon the work of naturalist-travellers in general, and of A. E. Brehm in particular. Mr. Thomson gives a list of works by English naturalist-travellers, in which we notice Fred Burnaby's "Ride to Khiva," although such books as Lamont's "With the Sea Horses," Butler's "Great Lone Land," and Whymper's "Travels among the Andes of the Equator," are not mentioned.

Mr. Thomson classifies naturalist-travellers into five groups—the Romantic (including Sir John de Maundeville and other mediæval story-tellers); the Encyclopædists of the sixteenth and seventeenth centuries; the General Naturalists, ranging from Ray to Humboldt; the Specialist Type—the naturalists of the naval expeditions

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